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EXAMINER	
BETZ, BLAKE E	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/601,428	Applicant(s) GANGNET ET AL.	
	Examiner Blake E. Betz	Art Unit 2672	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on ____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-41 is/are pending in the application.

4a) Of the above claim(s) ____ is/are withdrawn from consideration.

5)☐ Claim(s) ____ is/are allowed.

6)☒ Claim(s) 1-32 and 34-41 is/are rejected.

7)☒ Claim(s) 33 is/are objected to.

8)☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on ____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 2.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. ____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: ____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 3 – 6, 21, 23 – 25, 27, 28, 37, 39, 40, and 41 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 6,271,861 to Sargent et al.

Sargent fully discloses the color gradient generation system in claim 1 wherein information is received associated with at least one boundary curve, zero or more feature curves and colors associated with the boundary curve and the feature curve. Column 1, lines 38 – 43 states, "In one aspect, the invention provides a method for defining a smooth shading across an object for display on a raster output device and includes converting the object to a mesh, rendering the mesh, displaying the object having a shading defined by the mesh and editing the mesh until a desired result is achieved in the displayed object." Lines 44 – 55 state, "The step of converting the

object into a mesh may include determining a boundary for the object enclosed by a boundary box having four corners, determining four points on a boundary of the object that are closest to the four corners of the boundary box, determining four edges on the boundary of the box that connect the four corners, constructing a mesh from the four edges and four corners on the boundary of the object resulting in a single patch mesh including four mesh points corresponding to the four corner point on the boundary, selecting a shading procedure and determining colors to the four mesh points." Thus, a color gradient is generated based on points on the boundary curve and the associated color corresponding to those points. Lines 57 – 64 state, "The step of determining colors may include receiving a user selection for the colors. The method may further include receiving a user selection to define the number and arrangement of patches in the mesh where the mesh is of to be of form the form of an N.times.M matrix of patches, subdividing the mesh at N-1 regular intervals in a u direction of the mesh and subdividing the mesh at M-1 regular intervals in a v direction of the mesh." Thus, information is received associated with the boundary curve and the colors associated with the boundary curve.

Sargent fully discloses the color gradient generation system in claim 3 wherein the information received by the input component is based, at least in part, upon user input. Column 1, lines 65 – 67 states, "The shading procedure may determine the colors by receiving a color selection for each corner from a palette of available colors where the selection is performed by the user." Column 10 describes an I/O controller coupled to an I/O interface by means of an I/O bus. Lines 14 – 18 state, "Optionally, a

display 28, a keyboard 29 and a pointing device (mouse) 31 may also be connected to I/O bus 26. Alternatively, separate connections (separate buses) may be used for I/O interface 27, display 28, keyboard 29 and pointing device 30." Therefore, the system of Sargent teaches of information being received by the input component being based upon user input from a keyboard or a mouse.

Sargent discloses the color gradient generation system of claim 4 and 41 wherein information is received associated with at least one boundary curve, zero or more feature curves and colors associated with the boundary curve and the feature curve. Column 1, lines 57 – 64 states, "The step of determining colors may include receiving a user selection for the colors. The method may further include receiving a user selection to define the number and arrangement of patches in the mesh where the mesh is of to be of form the form of an N.times.M matrix of patches, subdividing the mesh at N-1 regular intervals in a u direction of the mesh and subdividing the mesh at M-1 regular intervals in a v direction of the mesh." Thus, information is received associated with the boundary curve and the colors associated with the boundary curve. Column 2, lines 4 – 9 states, "One or more edges of the boundary for the object may include multisegment cubic Bezier curves and the step of constructing a mesh may include constructing boundary edges for the mesh where the boundary edges are multisegment cubic Bezier curves having an identical number of segments as their corresponding edge in the boundary." Thus, Sargent teaches of an intermediate representation component that provides an intermediate approximation of the boundary curve based on line segments approximating the boundary curve. Since the method of

Sargent uses zero feature curves, line segments are not needed to approximate the feature curves. Column 2, lines 10 - 12 states, "The step of editing the mesh may include adding mesh points and defining colors for mesh points resulting in the uniform subdivision of the mesh at the new mesh point." Column 3, lines 57 – 66 states, "In one implementation, a Cartesian, or rectangular, mesh structure with four boundary curves 117 is defined. Alternatively, a polar mesh structure, i.e. one that uses polar coordinates may be used. Other implementations may use other topologies or structures as is known in the art.

Mesh 116 may be used to describe a non-linear color gradient over object 110. Mesh 116 may include a collection of adjoining patches 109 with shared edges. Alternatively, mesh 116 may be of the form of a single patch mesh and include a single patch 109." Column 4, lines 4 – 9 teach of employing an interpolation method to generate a color gradient on a patch within the mesh of an object. "Patch 109 is a two-dimensional parametric surface. An associated color function interpolates corner colors across the parametric surface. A bi-linear interpolation may be used or other interpolation methods may be selected. A gradient is defined by the mapping from interpolated colors on the parametric surface to points within the object." Thus, the system of Sargent also discloses a gradient generator that generates a color gradient based, at least in part, upon the line segments approximating the boundary curve and the colors associated with the boundary curve.

Sargent discloses the system in claim 5 wherein the color gradient of claim 4 is stored in a regular grid representation. Column 3, lines 57 – 58 states, "In one

implementation, a Cartesian, or rectangular, mesh structure with four boundary curves 117 is defined." Column 4, lines 4 – 6 states, "Patch 109 is a two-dimensional parametric surface. An associated color function interpolates corner colors across the parametric surface." Lines 9 – 13 state, "Each patch in the mesh has an associated unit square with equivalent topology. Each unit square has 4 corners with 4 associated colors. Shared edges share corner colors. A mesh allows the user to create a complex geometry in the gradient." Thus, the system of Sargent includes storing the color gradient in a regular, unit square, grid representation.

Sargent discloses the system in claim 6 wherein the color gradient of claim 4 is stored as a triangulation representation with colors defined at vertices of triangles. Column 4, lines 4 – 6 states, "Patch 109 is a two-dimensional parametric surface. An associated color function interpolates corner colors across the parametric surface." Column 6, lines 58 – 60 states, "Conventional rendering schemes include steps of dividing each patch into triangles (or polygons) and the subsequent rendering of the triangles." Thus, the system of Sargent includes a color gradient patch stored as a triangulation representation with the colors defined at the corners of the triangles.

Sargent discloses the system in claim 21 wherein the boundary curve and the feature curve of claim 4 are non-intersecting. The method of Sargent does not describe the boundary curves as intersecting and uses zero feature curves, therefore the boundary curves and feature curves in the system of Sargent do not intersect.

Sargent discloses the system in claim 23 wherein the boundary curve is represented as a cubic Bezier curve. Column 2, lines 4 – 9 states, "One or more edges

of the boundary for the object may include multisegment cubic Bezier curves and the step of constructing a mesh may include constructing boundary edges for the mesh where the boundary edges are multisegment cubic Bezier curves having an identical number of segments as their corresponding edge in the boundary."

Sargent discloses the system in claim 24 wherein the input component receives information associated with the boundary curve in two-dimensions. Column 4, lines 22 – 23 states, "For the creation of gradients, two-dimensional curves are used." Thus, a two-dimensional curve is used for the creation of the color gradient of the boundary curve in the system of Sargent.

Sargent discloses the system in claim 25 wherein the color gradient of claim 4 is resolution independent. Sargent does not include the method such that the color gradient is resolution dependent; therefore the system of Sargent is considered resolution independent.

Sargent fully discloses the system in claim 27 wherein the information received by the input component in claim 4 is based, at least in part, upon user input. Column 1, lines 65 – 67 states, "The shading procedure may determine the colors by receiving a color selection for each corner from a palette of available colors where the selection is performed by the user." Column 10 describes an I/O controller coupled to an I/O interface by means of an I/O bus. Lines 14 – 18 state, "Optionally, a display 28, a keyboard 29 and a pointing device (mouse) 31 may also be connected to I/O bus 26. Alternatively, separate connections (separate buses) may be used for I/O interface 27, display 28, keyboard 29 and pointing device 30." Therefore, the system of Sargent

teaches of information being received by the input component being based upon user input from a keyboard or a mouse.

Sargent fully discloses the system in claim 28 wherein the gradient generator performs at least one refinement of the color gradient. Column 2, lines 30 – 36 states, "The method includes converting the object to a mesh including creating a mesh boundary that includes edges that include a same number of segments as a corresponding edge in the boundary of the object, rendering the mesh, displaying the object having a shading defined by the mesh and editing the mesh until a desired result is achieved in the displayed object." Thus by editing the mesh until a desired result is achieved, the method of Sargent performs at least one refinement of the color gradient.

Sargent discloses the method in claim 37 of generating a color gradient comprising: receiving information associated with an input path; receiving a request for the color gradient to be generated; and, generating the color gradient based, at least in part, on the input path information. Column 3, lines 38 – 55 states, "IGS. 2a and 2b show a two-dimensional object 110 displayed in a display space 112. Workspace 112 is generated by a graphical user interface associated with a drawing application (not shown) executing on computer 10 (FIG. 11). Object 110 defines a region 114 of arbitrary shape and size. A two-dimensional shading of region 114 is defined by a mesh 116 which may be superimposed over object 110 and displayed in display space 112 by manipulation of the graphical user interface associated with the drawing application. Mesh 116 may be modified by a user to adjust a color gradient across region 114.

Mesh 116 is a user-editable structure created from a graphic object (e.g., object 110). Color may be applied to certain points in mesh 116 resulting in the smooth shading of the area enclosed by mesh 116. Mesh 116 is rendered in a user-defined (x,y) coordinate space. Color interpolation and other operations and properties are defined in a parameterized (u,v) coordinate space." Thus, the method of Sargent receives information associated with an input path and generates a color gradient based, at least in part, upon the input path information in response to a request from a user for the gradient to be generated.

Sargent discloses the transfer of data between two or more computer components that facilitates generation of a color gradient as described in claim 39. Column 9, lines 65 – 67 and Column 10, lines 1 – 32 describe the components and interfaces of the processing system used to implement the invention of Sargent. "Computer 10 may optionally include a hard drive controller 23 which is coupled to a hard disk 30 and CPU bus 25. Hard disk 30 may be used for storing application programs, such as the present invention, and data. Alternatively, application programs may be stored in RAM or ROM." "I/O controller 24 is coupled by means of an I/O bus 26 to an I/O interface 27. I/O interface 27 receives and transmits data in analog or digital form over communication links such as a serial link, local area network, wireless link, and parallel link. Optionally, a display 28, a keyboard 29 and a pointing device (mouse) 31 may also be connected to I/O bus 26." "The invention may be embodied in a computer program that is tangibly stored in a machine-readable storage media or device readable by a general or special purpose programmable computer, for

configuring and controlling operation of a computer when the storage media or device is read by the computer to perform the procedures described herein. The inventive system may also be considered to be embodied in a computer-readable storage medium, configured with a computer program, where the storage medium so configured causes a computer to operate in a specific and predefined manner to perform the functions described herein." Thus, the system of Sargent includes instances of transmitting data across networks from one computer to another, from memory components to the CPU via a bus connection, and from a computer to a display via an I/O interface. The displaying of the color gradient on the display involves the transmission of color gradient information between the computer and display across the I/O interface. The color gradient is based upon the program stored in the memory components of the system as defined by Sargent.

Sargent discloses the computer readable medium storing computer executable components of a color gradient generation system of claim 40 wherein information is received associated with at least one boundary curve, zero or more feature curves and colors associated with the boundary curve and the feature curve. Column 2, lines 4 – 9 states, "One or more edges of the boundary for the object may include multisegment cubic Bezier curves and the step of constructing a mesh may include constructing boundary edges for the mesh where the boundary edges are multisegment cubic Bezier curves having an identical number of segments as their corresponding edge in the boundary." Thus, Sargent teaches of an intermediate representation component that provides an intermediate approximation of the boundary curve based on line segments

approximating the boundary curve. Since the method of Sargent uses zero feature curves, line segments are not needed to approximate the feature curves. Column 2, lines 10 - 12 states, "The step of editing the mesh may include adding mesh points and defining colors for mesh points resulting in the uniform subdivision of the mesh at the new mesh point." Column 3, lines 57 – 66 states, "In one implementation, a Cartesian, or rectangular, mesh structure with four boundary curves 117 is defined. Alternatively, a polar mesh structure, i.e. one that uses polar coordinates may be used. Other implementations may use other topologies or structures as is known in the art.

Mesh 116 may be used to describe a non-linear color gradient over object 110. Mesh 116 may include a collection of adjoining patches 109 with shared edges. Alternatively, mesh 116 may be of the form of a single patch mesh and include a single patch 109." Column 4, lines 4 – 9 teach of employing an interpolation method to generate a color gradient on a patch within the mesh of an object. "Patch 109 is a two-dimensional parametric surface. An associated color function interpolates corner colors across the parametric surface. A bi-linear interpolation may be used or other interpolation methods may be selected. A gradient is defined by the mapping from interpolated colors on the parametric surface to points within the object." Thus, the system of Sargent also discloses a gradient generator that generates a color gradient based, at least in part, upon the line segments approximating the boundary curve and the colors associated with the boundary curve. Column 10, lines 22 – 32 states, "The invention may be embodied in a computer program that is tangibly stored in a machine-readable storage media or device readable by a general or special purpose

programmable computer, for configuring and controlling operation of a computer when the storage media or device is read by the computer to perform the procedures described herein. The inventive system may also be considered to be embodied in a computer-readable storage medium, configured with a computer program, where the storage medium so configured causes a computer to operate in a specific and predefined manner to perform the functions described herein." Thus, Sargent discloses a computer readable medium storing computer executable components of a color gradient generation system comprising the components of claim 40.

Claims 2, 7, 9, 11, 16 – 20, 26, 30 – 32, 35, and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,271,861 to Sargent et al. in view of Ballester et al.

Claims 2 and 26 are disclosed by Sargent except wherein the colors in the system of claim 1 and 4 are represented in one of grayscale color space; red, green blue color space; hue, saturation and value color space; hue, lightness and saturation color space; CIE L*a*b color space; CIE XYZ color space; cyan, magenta, yellow, black color space; and a spectral basis function color space. The method of Ballester teaches of filling in regions of missing data in an image. Page 1201, second column states, "The algorithm also introduces the importance of propagating both the gradient direction (geometry) and gray-values (photometry) of the image in a band surrounding the hole to be filled-in." Thus, the method of Ballester teaches of representing the colors of the regions to be filled-in with a grayscale color space. It would have been obvious to one having ordinary skill in the art at the time the invention was made to further modify the

system of Sargent in claims 1 and 4 to include the method of Ballester to include representing the colors in the system in grayscale color space. One would have been motivated to make such a modification to the system of Sargent to represent the colors in the system in a grayscale color space so that the shading of an object can be performed as described by the motivation of the invention of Sargent.

The system of claim 7 is disclosed by Sargent except wherein the gradient generator employs a vector-based interpolation method. The method of Ballester teaches of employing a vector-based interpolation method to fill in a region of an image by smoothly continuing color gradient information from a boundary into the region being filled. Section C covering pages 1205 – 1209 of Ballester describe the use of vector fields in the interpolation of grayscale values inside the region to be filled. It would have been obvious to one having ordinary skill in the art of color gradient paths at the time the invention was made to further modify the system of Sargent to include the method of Ballester such that the color gradient generator employs a vector-based interpolation method. One would have been motivated to make such a modification to the system of Sargent in view of Ballester so that the information from the boundary of a region to be filled is smoothly continued into the region.

The system of claim 9 is disclosed by Sargent except wherein the gradient generator employs a partial differential equation interpolation method, the color gradient being based, at least in part, to a solution to a partial differential equation. The method of Ballester teaches of employing partial differential equation wherein the grayscale gradient is based, at least in part, to a solution to a partial differential equation. Page

1201, first column, last paragraph notes, "Recently, we have addressed the concept of smooth continuation of information in the level-lines direction in [6], [7]. We proposed an algorithm, inspired by partial differential equations, that propagates the image Laplacian in this direction. The algorithm attempts to imitate basic approaches used by professional restorators. The algorithm also introduces the importance of propagating both the gradient direction (geometry) and gray-values (photometry) of the image in a band surrounding the hole to be filled-in. It is part of the goal of the current paper to adopt some of the ideas of [6] and [7], while deviating from the particular model in order to be able to define a formal variational approach to the filling-in problem." It would have been obvious to one having ordinary skill in the art at the time the invention was made to further modify the system of Sargent to include the method of Ballester such that the grayscale gradient is based, at least in part, to a solution to a partial differential equation. One would have been motivated to make such a modification to Sargent to facilitate the generation of smooth color gradients on a variety of object representations such as an irregular triangle mesh, on a regular grid of vertices, or on a raster bitmap containing a rectangular grid of pixels.

The system of claim 11 is disclosed by Sargent as modified by Ballester wherein the solution to the partial differential equation is based, at least in part, upon Laplace's equation. Page 1201, second column, first line states, "We proposed an algorithm, inspired by partial differential equations, that propagates the image Laplacian in this direction."

The system of claim 16 is disclosed by Sargent in view of Ballester as applied to claim 9 wherein the intermediate representation component provides an intermediate representation based, at least in part, upon a raster grid utilized to approximate at least one of the boundary curve(s) and the feature curve(s). Column 2, lines 26 – 30 states, "In another aspect, the invention provides a method for defining a smooth shading across an object for display on a raster output device where the object includes a boundary comprising edges at least one of which is a multisegment curve." Thus, the system of Sargent includes approximating at least one of the boundary curves in a multisegment intermediate representation based on a raster grid for display on a raster output device.

The system of claims 17 and 18 is disclosed by Sargent in view of Ballester as applied to claim 9 wherein the color gradient is regenerated based, at least in part, upon the solution to the partial differential equation being re-calculated and solved for the display of a higher resolution shading gradient. Sargent in view of Ballester applies a partial differential equation upon which the interpolation method of the gradient generator is, at least in part, based. The mesh of Sargent is rendered then edited until a desired result is achieved in the shading of the displayed object. Column 2, lines 30 – 36 states, "The method includes converting the object to a mesh including creating a mesh boundary that includes edges that include a same number of segments as a corresponding edge in the boundary of the object, rendering the mesh, displaying the object having a shading defined by the mesh and editing the mesh until a desired result is achieved in the displayed object." Thus, the shading defined by the mesh is re-

calculated to regenerate a higher resolution of shading for the displayed object until a desired result is achieved.

The system of claim 19 is disclosed by Sargent in view of Ballester as applied to claim 9 wherein the solution to the partial differential equation is triangulated. Column 1, lines 58 – 64 states, "The method may further include receiving a user selection to define the number and arrangement of patches in the mesh where the mesh is of to be of form the form of an N.times.M matrix of patches, subdividing the mesh at N-1 regular intervals in a u direction of the mesh and subdividing the mesh at M-1 regular intervals in a v direction of the mesh." Column 4, lines 4 – 6 states, "Patch 109 is a two-dimensional parametric surface. An associated color function interpolates corner colors across the parametric surface." Column 6, lines 58 – 60 states, "Conventional rendering schemes include steps of dividing each patch into triangles (or polygons) and the subsequent rendering of the triangles." Thus, the system of Sargent includes triangulating the mesh as defined by the interpolation of the color gradient, the color gradient being based, at least in part, to the solution to the partial differential equation.

The system of claim 20 is disclosed by Sargent in view of Ballester as applied to claim 19 wherein the triangulation is employed for at least one of rendering and re-calculating the solution to the partial differential equation at a higher resolution. Column 2, lines 30 – 36 states, "The method includes converting the object to a mesh including creating a mesh boundary that includes edges that include a same number of segments as a corresponding edge in the boundary of the object, rendering the mesh, displaying the object having a shading defined by the mesh and editing the mesh until a desired

result is achieved in the displayed object." Thus, the shading defined by the triangulated mesh of claim 19 is re-calculated to render a higher resolution of shading for the displayed object until a desired result is achieved.

The system of claim 30 is disclosed by Sargent except wherein a vector-valued field is defined on the boundary and matching a vector-valued field generated throughout the interior of the region to the field defined on the boundary. As noted above, the system of Sargent includes an input component that receives information associated with a boundary curve and an intermediate representation component that provides an intermediate approximation of the boundary. The method of Ballester uses a vector field to continue data into a region from data outside the hole. Page 1200, second column notes, "We want to fill-in the hole Ω based on the geometric and photometric information outside the hole. For that we use what we call a band around Ω, i.e., we consider an open region of such that (is the closure of the set). The band we refer to will be the set B. To fill-in the hole Ω we use the information of μ_0 contained in B, mainly gray level and the vector field of isophotes (level sets) directions of μ_0 in B.1 We attempt to continue the level sets of μ in B inside Ω taking into account the principle of good continuation." Thus, the method of Ballester continues the vector field from outside the hole to be filled in inside the hole. In this way, a vector field is generated inside the hole that matches the vector field where it is defined on the boundary of the hole. It would have been obvious to one having ordinary skill in the art of color gradient paths at the time that the invention was made to modify the system of Sargent to include the method of Ballester such that a vector-valued field is generated inside the

region defined by a boundary where the generated field matches the input vector-valued field where it is defined on the boundary. One would have been motivated to make such a modification to the system of Sargent in view of Ballester so that the color gradient information contained by the boundary of a region to be filled in is smoothly continued into the region.

The method of claim 31 is disclosed by Sargent except wherein the color gradient is facilitated by a vector-based interpolation method. The method of Sargent includes approximating one or more input boundary curves and zero or more feature curves with line segments; and, triangulating a resulting graph formed by a set of vertices and edges defined by the line segments. Column 2, lines 26 – 36 states, "In another aspect, the invention provides a method for defining a smooth shading across an object for display on a raster output device where the object includes a boundary comprising edges at least one of which is a multisegment curve. The method includes converting the object to a mesh including creating a mesh boundary that includes edges that include a same number of segments as a corresponding edge in the boundary of the object, rendering the mesh, displaying the object having a shading defined by the mesh and editing the mesh until a desired result is achieved in the displayed object." Column 3, lines 57 – 60 states, "In one implementation, a Cartesian, or rectangular, mesh structure with four boundary curves 117 is defined. Alternatively, a polar mesh structure, i.e. one that uses polar coordinates may be used." Column 4, lines 4 – 13 states, "Patch 109 is a two-dimensional parametric surface. An associated color function interpolates corner colors across the parametric surface. A bi-linear

interpolation may be used or other interpolation methods may be selected. A gradient is defined by the mapping from interpolated colors on the parametric surface to points within the object. Each patch in the mesh has an associated unit square with equivalent topology. Each unit square has 4 corners with 4 associated colors. Shared edges share corner colors. A mesh allows the user to create a complex geometry in the gradient." Lines 57 – 62 state, "A mesh point 124 is formed at the intersection of a u-axis and a v-axis gridline 120. A mesh point 124 includes a user-editable color.
An edge point 126 is a point on an edge (between two mesh points) which is a shared point between two consecutive cubic Bezier segments defining an edge. Edge points 126 may be hard or soft." Column 6, lines 58 – 65 states, "Conventional rendering schemes include steps of dividing each patch into triangles (or polygons) and the subsequent rendering of the triangles." Column 7, lines 49 – 52 states, "The color at the mesh point is specified (614). The color may be specified by the user selecting a color from a color palette or by interpolation of the corner colors of the patch in which the mesh point is located." Thus, a mesh of triangular patches is triangulated on the resulting graph formed by a set of vertices and edges defined by the boundary curves, the boundary curves being approximated with line segments. Ballester teaches of a method wherein interpolation of a color gradient across a region is vector-based. The abstract on page 1200 notes, "A variational approach for filling-in regions of missing data in digital images is introduced in this paper. The approach is based on joint interpolation of the image gray-levels and gradient/isophotes directions, smoothly extending in an automatic fashion the isophote lines into the holes of missing data."

Page 1200, second column states, "To fill-in the hole Ω we use the information of μ_o contained in B, mainly gray level and the vector field of isophotes (level sets) directions of μ_o in B." Thus, the approach of Ballester uses a vector-based interpolation method facilitating a color gradient. It would have been obvious to one having ordinary skill in the art of color gradient paths to modify the method of Sargent to include the technique of Ballester such that the color gradient generation includes a vector-based interpolation approach. One would have been motivated to make such a modification to the method of Sargent such that the color information outside the region to be filled in on the boundary can continue smoothly inside the region.

The method of claim 32 is disclosed by Sargent in view of Ballester as applied to claim 31. Column 7, lines 11 – 22 states, "In one implementation, a mesh is rendered according to a rendering process 500 as shown in FIG. 6. A first mesh is retrieved (502). The mesh is subdivided at each edge point to generate a series of patches that are characterized by boundary curves which are single cubic Beziers (504). Each resulting patch is further subdivided to remove discontinuities in first order derivatives of color across patch boundaries (506). Resulting patches are ordered to resolve any foldover conditions (508) and then sent according to the order to a rendering engine for rendering (510). A check is made to determine if more patches in the mesh need to be processed (512)." Thus, Sargent checks whether a refinement criteria has been met with the patches. Lines 25 – 48 describe editing the mesh after creation by adding mesh points and grid lines. By adding more points and grid lines to a mesh of triangular patches, it is obvious that the added points and lines will create an addition in the

number of vertices and triangles due to the interaction of the added and established grid lines. Lines 49 – 52 describe specifying a color at the mesh point. "The color at the mesh point is specified (614). The color may be specified by the user selecting a color from a color palette or by interpolation of the corner colors of the patch in which the mesh point is located." Lines 62 – 65 describe smoothing the color, "In order to achieve smooth shading through each of these new mesh points, the color at these new mesh points may be determined by interpolating between color values of existing mesh points within or on the boundary of the mesh." Column 8, lines 13 – 26 describes determining new edge curves and the generation of soft edge points on a new gridline such that smooth transitions of color exists between the boundary and gridline. "The new gridline comprises a series of edge curves 122-1, 122-2, 122-3 coupled between pairs of the mesh points. Individual edge curves 122-1, -2 and -3 may be generated by interpolation between boundary 117-4 and gridline 120-4 in between which new gridline 120-1 is disposed. Specifically, interpolation between the corresponding individual segments of the boundary line and the old grid line is performed to derive each new edge curve for the new gridline 120-4. The interpolation between curves may result in the generation of soft edge points on new gridline 120-4." Thus, the positions of the added vertices are positioned such that the smoothness of the colors between existing mesh points is assured.

The method of claim 35 is disclosed by Sargent except wherein the smoothing of vertex positions and/or colors is accomplished using Laplacian smoothing. The method of Ballester employs the use of Laplacian smoothing for the smooth continuation of

level-lines in the region to be filled. Page 1201, bottom of the first column notes, "Recently, we have addressed the concept of smooth continuation of information in the level-lines direction in [6], [7]. We proposed an algorithm, inspired by partial differential equations, that propagates the image Laplacian in this direction." It would have been obvious to one having ordinary skill in the art of color gradient paths at the time the invention was made to further modify the method of Sargent to include the method of Ballester such that the smoothing of vertex positions and/or colors is accomplished using Laplacian smoothing. One would have been motivated to make such a modification to the method of Sargent such that, "The algorithm also introduces the importance of propagating both the gradient direction (geometry) and gray-values (photometry) of the image in a band surrounding the hole to be filled-in."

Sargent discloses the method of claim 36 except wherein a color gradient is generated based in part upon a solution to a partial differential equation; determining whether the partial differential solution is and/or an error is less than a threshold value; and, regenerating the color gradient if the partial differential solution is not finished and the error is not less than the threshold value. Column 2, lines 26 – 30 of Sargent discloses the use of a raster output device to display an object comprising a boundary edge made up of multisegment curves. "In another aspect, the invention provides a method for defining a gradient across an object for display on a raster output device where the object includes a boundary comprising multisegment edges." As noted above, a raster device displays a bitmap image; therefore, the input boundary curve to be displayed is rasterized onto a bitmap for display. The method of Ballester teaches of

employing partial differential equation wherein the grayscale gradient is based, at least in part, to a solution to a partial differential equation. Page 1201, first column, last paragraph notes, "Recently, we have addressed the concept of smooth continuation of information in the level-lines direction in [6], [7]. We proposed an algorithm, inspired by partial differential equations, that propagates the image Laplacian in this direction. The algorithm attempts to imitate basic approaches used by professional restorators. The algorithm also introduces the importance of propagating both the gradient direction (geometry) and gray-values (photometry) of the image in a band surrounding the hole to be filled-in. It is part of the goal of the current paper to adopt some of the ideas of [6] and [7], while deviating from the particular model in order to be able to define a formal variational approach to the filling-in problem." It would have been obvious to one having ordinary skill in the art at the time the invention was made to further modify the system of Sargent to include the method of Ballester such that the grayscale gradient is based, at least in part, to a solution to a partial differential equation. One would have been motivated to make such a modification to Sargent to facilitate the generation of smooth color gradients on a variety of object representations such as an irregular triangle mesh, on a regular grid of vertices, or on a raster bitmap containing a rectangular grid of pixels. It is obvious to one having ordinary skill in the art of color gradient paths that a partial differential equation is finished if a solution to the equation is found. Sargent discloses regenerating the color gradient until a desired result is achieved. Column 2, lines 30 – 36 states, "The method includes converting the object to a mesh including creating a mesh boundary that includes edges that include a same number of segments

as a corresponding edge in the boundary of the object, rendering the mesh, displaying the object having a shading defined by the mesh and editing the mesh until a desired result is achieved in the displayed object." It is obvious to one having ordinary skill in the art of color gradient paths that if an achieved result is different than a desired result, that there inherently lies an error between the results and what was expected. By applying a check to determine if a given mesh has achieved a desired result, Sargent is determining if a threshold of acceptance has been accomplished.

Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sargent in view of U.S. Patent No. 5,701,404 to Stevens et al.

Sargent discloses the system of claim 22 except wherein the input component receives a plurality of intersecting boundary curves then separates the plurality of intersecting curves into a set of non-intersecting curves. The method of Stevens teaches of trimming a non-uniform rational B-spline (NURBS) surface with a projected curve. If curves defining the trim region overlap any pre-existing curves then a process determines if the curves intersect one another. If the two curves are found to intersect, the curves are split at the intersection point. Column 14, lines 1 – 4 states, "If a curve/curve intersection is found, the two curve segments involved are split at the intersection point, and data are kept for the point indicating the direction to follow when traversing the curve." Thus, the intersecting curves are split into a set of non-intersecting curves. It would have been obvious to one having ordinary skill in the art of color gradient paths to modify the system of Sargent to include the method of Stevens so that if a boundary curve has a plurality of intersecting curves, the intersecting curves

are separated into a set of non-intersecting curves. One would have been motivated to make such a modification to the system of Sargent so that in the event of receiving a boundary with intersecting curves, the curves can be separated into a set of non-intersecting curves defining distinct regions.

Claims 8 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sargent in view of Ballester as applied to claims 7 and 9, respectively, above, and further in view of Murray et al.

The system of claims 8 and 10 are disclosed by Sargent in view of Ballester as applied to claims 7 and 9, respectively. Column 2, lines 26 – 30 of Sargent discloses the use of a raster output device to display an object comprising a boundary edge made up of multisegment curves. "In another aspect, the invention provides a method for defining a gradient across an object for display on a raster output device where the object includes a boundary comprising multisegment edges." Murray discloses various conventions of graphics data. The first paragraph of section "Sources of Bitmap Data: Raster Devices" explains, "Historically, the term *raster* has been associated with cathode ray tube (CRT) technology and has referred to the pattern of rows the device makes when displaying an image on a picture tube. Raster-format images are therefore a collection of pixels organized into a series of rows, which are called *scan lines*. Because raster output devices, by far the most popular kind available today, display images as patterns of pixels, pixel values in a bitmap are usually arranged so as to make them easy to display on certain common raster devices. For these reasons, bitmap data is often called *raster data*. We use the term *bitmap data*." Thus, by using a

raster output device to display the object, Sargent must use polylines to represent the multisegment Bezier curves of the boundary curve to be displayed on the scan lines of the device. The first paragraph of section, "Bitmap Data" explains, "*Bitmap data* is formed from a set of numerical values specifying the colors of individual *pixels* or *picture elements* (*pels*). Pixels are dots of color arranged on a regular grid in a pattern representing the form to be displayed. We commonly say that a bitmap is an *array of pixels*, although a bitmap, technically, consists of an *array of numerical values* used to set, color, or "turn on" the corresponding pixels on an output device when the bitmap is rendered. If there is any ambiguity in the text, we will make the distinction clear by using the term *pixel value* to refer to a numerical value in the bitmap data corresponding to a pixel color in the image on the display device." Thus, Murray teaches that data to be displayed on a raster device, as used in the system of Sargent, is inherently bitmap data. Therefore, the system of Sargent rasterizes the boundary curve comprised of the multisegment Bezier curves onto a bitmap for display.

Claims 12 – 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sargent in view of Ballester as applied to claim 9 above, and further in view of Dalziel.

Sargent in view of Ballester discloses the system of claims 12, 13, and 14 except wherein the solution to the partial differential equation is based, at least in part upon a finite differences approach, a successive over-relaxation approach, and a multi-grid solver approach, respectively. Dalziel teaches of solving partial differential equations in a variety of methods including: finite differences approach, successive over-relaxation approach, and a multi-grid solver approach. Pages 1 – 9 of Dalziel uses a partial

differential equation represented in a two dimensional Laplacian equation to show that each method is able to solve the partial differential equation. Therefore, it would have been obvious to one having ordinary skill in the art of mathematics at the time the invention was made to further modify the method of Sargent in view of Ballester to include the method of Dalziel to solve the partial differential equation of claim 9 by the use of the finite differences approach, successive over-relaxation approach, and a multi-grid solver approach. One would have been motivated to make such a modification to the method of Sargent in view of Ballester so that the partial differential equation can be solved by different methods based on the accuracy required, the time required for the computation of the solution, and the amount of system resources available at the time of the computation of the partial differential equation.

Sargent in view of Ballester and Dalziel as applied to claims 12, 13, and 14 discloses the system of claim 15 wherein dynamic re-calculation of the solution to the partial differential equation at a higher resolution is provided by applying a multi-grid step to obtain a refinement of the initial solution to the partial differential equation. Sargent in view of Ballester and Dalziel applies a multi-grid solver approach to solve a solution to a partial differential equation upon which the interpolation method of the gradient generator is, at least in part, based. The mesh of Sargent is rendered then edited until a desired result is achieved in the shading of the displayed object. Column 2, lines 30 – 36 states, "The method includes converting the object to a mesh including creating a mesh boundary that includes edges that include a same number of segments as a corresponding edge in the boundary of the object, rendering the mesh, displaying

the object having a shading defined by the mesh and editing the mesh until a desired result is achieved in the displayed object." Thus, refinement of the shading defined by the mesh is re-calculated to achieve a higher resolution of shading for the displayed object until a desired result is achieved.

Claim 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sargent in view of Ballester as applied to claim 32 above, and further in view of U.S. Patent No. 5,333,248 to Christensen.

Sargent in view of Ballester discloses the method of claim 34 except wherein the refinement of the triangulation is accomplished by adding a new vertex located at the centroid of each triangle in need of refinement. Christensen uses a triangulation mesh comprising a plurality of triangles to differentially smooth raw isolines containing linear segments. Column 4, lines 21 – 27 states, "It is another object of the present invention to provide a method and system for smoothing raw isolines associated with a triangular mesh. It is yet another object of the present invention to provide a method and system for smoothing raw isolines associated with a triangular mesh to provide an isoline map." Column 7, lines 6 – 7 describes the centroid of a triangle, "A centroid of a triangle is the intersection of three medians of the triangle." Column 7, lines 24 – 26 describes the function of creating a sub-triangle of a triangle in the mesh. "The sub-triangle of a triangle edge is formed by the triangle centroid, i.e., CN.sub.1, and the opposite edge; P.sub.3 -P.sub.1." Thus, editing of the triangulation mesh of Christensen includes the method of adding a new vertex located at the centroid of each triangle in need of refinement by the addition of a sub-triangle. It would have been obvious to one having

ordinary skill in the art of color gradient paths to further modify the method of Sargent so that upon editing the triangular mesh of an object, a new vertex is added whose location is at the centroid of each triangle in need of refinement. One would have been motivated to make such a modification to the method of Sargent so that upon editing of a triangulated mesh, the colors being displayed at the vertices of the triangular patches will be distanced from one another using a uniform algorithm in an effort for an aesthetically pleasing appearance.

Claims 29 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,271,861 to Sargent et al. in view of U.S. PGPUB 20040090437 to Uesaki et al.

Sargent discloses the color gradient generation system of claim 29 wherein the input boundary is a surface. Sargent describes a system wherein information is received associated with at least one boundary curve, zero or more feature curves and colors associated with the boundary curve and the feature curve. Column 1, lines 57 – 64 states, "The step of determining colors may include receiving a user selection for the colors. The method may further include receiving a user selection to define the number and arrangement of patches in the mesh where the mesh is of to be of form the form of an N.times.M matrix of patches, subdividing the mesh at N-1 regular intervals in a u direction of the mesh and subdividing the mesh at M-1 regular intervals in a v direction of the mesh." Thus, information is received associated with the boundary curve and the colors associated with the boundary curve. Column 2, lines 4 – 9 states, "One or more edges of the boundary for the object may include multisegment cubic Bezier curves and

the step of constructing a mesh may include constructing boundary edges for the mesh where the boundary edges are multisegment cubic Bezier curves having an identical number of segments as their corresponding edge in the boundary." Thus, Sargent teaches of an intermediate representation component that provides an intermediate approximation of the boundary curve based on line segments approximating the boundary curve. Since the method of Sargent uses zero feature curves, line segments are not needed to approximate the feature curves. Column 2, lines 10 - 12 states, "The step of editing the mesh may include adding mesh points and defining colors for mesh points resulting in the uniform subdivision of the mesh at the new mesh point." Column 3, lines 57 – 66 states, "In one implementation, a Cartesian, or rectangular, mesh structure with four boundary curves 117 is defined. Alternatively, a polar mesh structure, i.e. one that uses polar coordinates may be used. Other implementations may use other topologies or structures as is known in the art.

Mesh 116 may be used to describe a non-linear color gradient over object 110. Mesh 116 may include a collection of adjoining patches 109 with shared edges. Alternatively, mesh 116 may be of the form of a single patch mesh and include a single patch 109." Column 4, lines 4 – 9 teach of employing an interpolation method to generate a color gradient on a patch within the mesh of an object. "Patch 109 is a two-dimensional parametric surface. An associated color function interpolates corner colors across the parametric surface. A bi-linear interpolation may be used or other interpolation methods may be selected. A gradient is defined by the mapping from interpolated colors on the parametric surface to points within the object." Thus, the

system of Sargent also discloses a gradient generator that generates a color gradient based, at least in part, upon the boundary being approximated by two-dimensional patch surface segments and colors associated with the boundary. The system of Uesaki describes the use of surfaces in rendering objects with high image quality. Uesaki takes an input surface and divides the surface into polygon patches. A rendering process then shades the patches to create a shading of the surface. It would have been obvious to one having ordinary skill in the art of color gradient paths to modify the system of Sargent to include the method of Uesaki so that the input of Sargent comprises of receiving a boundary surface. One would have been motivated at the time the invention was made to modify the system of Sargent to include receiving a boundary surface with colors associated with the boundary surface so that further computation would not be required by the system of Sargent to determine the surface enclosed by the boundary curve. Additionally, the use of surfaces as boundaries allows for the shading of a three-dimensional object bounded by surfaces.

Sargent discloses the color gradient generation method of claim 38 except wherein the approximated line segments of an input path are converted into three, four, or five dimensional line segments. Sargent discloses a method of receiving information associated with an input path represented as a boundary curve and approximating the boundary curve with multisegment Bezier curves. Sargent also discloses a method of utilizing a two-dimensional smooth surface reconstruction algorithm to generate a color gradient that involves interpolating colors across a surface. Column 4, lines 4 – 6 states, "Patch 109 is a two-dimensional parametric surface. An associated color

function interpolates corner colors across the parametric surface." Lines 7 – 9 describe providing the color gradient to the original object. "A gradient is defined by the mapping from interpolated colors on the parametric surface to points within the object." Uesaki describes using a non-uniform rational B-spline (NURBS) curve to represent a surface due to their ability to represent smooth surfaces using few control points. Uesaki explains how these NURBS curves can be transformed into a Bezier curve. Page 4, paragraph 53 states, "For the sake of simplicity, a method of transforming a NURBS curve into a rational Bezier curve will be explained first." Uesaki further explains that the NURBS curves may be a two-dimensional curve or it may be a curve in three-dimensional space by adding a Z coordinate to the curve. Page 2, paragraph 28 states, "A NURBS curve is defined in 2D space which is easy to understand visually in FIG. 19 and the above equations, but it may be a NURBS curve in 3D space by adding the definition of a Z coordinate pz." Thus, the Bezier curve of a transformed NURBS curve in the method of Uesaki may be converted into a three-dimensional line segment. It would have been obvious to one having ordinary skill in the art of color gradient paths at the time the invention was made to modify the method of Sargent to include the method of Uesaki to convert line segments into three-dimensional line segments. One would have been motivated to make such a modification to the method of Sargent so that the boundary curves may outline surface objects of a three-dimensional object to be shaded one surface at a time.

Allowable Subject Matter

Claim 33 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. None of the prior art teaches of refinement criteria for a color gradient being based, at least in part, upon the equation as defined in claim 33.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following patens are cited to further show the state of the art with respect to color gradient paths:

U.S. Pat. No. 5,163,126 to Einkauf

U.S. Pat. No. 6,313,840 to Bilodeau

U.S. Pat. No. 6,784,896 to Perani

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Blake E. Betz whose telephone number is (703) 605-4584. The examiner can normally be reached on 7:30 - 4:00 M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Razavi can be reached on (703) 305-4713. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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